# CHEMISTRY 121 MIDTERM 1

Sept. 29, 2006

Show all your reasoning/work/sig. figs. for full marks

(1) 1) Correctly report the answer in the box provided.

all or nothing

$$\text{Log}\left[\frac{(17.9983)(2.45)}{4}\right] = \boxed{1.042\ (1)}$$

$\log(1.1024\times10^{1})$

(2) 2) Calculate the mass in grams of 11,455 phosphorus atoms (AW = 30.97 g/mol)

$$11{,}455\ \text{P atoms} \times \frac{1\ \text{mol}}{6.022\times10^{23}\ \text{atoms}} \times \frac{30.97\ \text{g}}{\text{mol}}\ (1)$$

$$= 5.891\times10^{-19}\ \text{g}\ (1)$$

not two names or two formulae

(2) 3) Write **ONE** correct name and **ONE** correct formula only. Your choice.

(1)/answer $Cu(OH)_2$ Copper(II)hydroxide

$Mg(HCO_3)_2$ Magnesium bicarbonate (or hydrogen carbonate)

Chromium(III)dichromate $Cr_2(Cr_2O_7)_3$

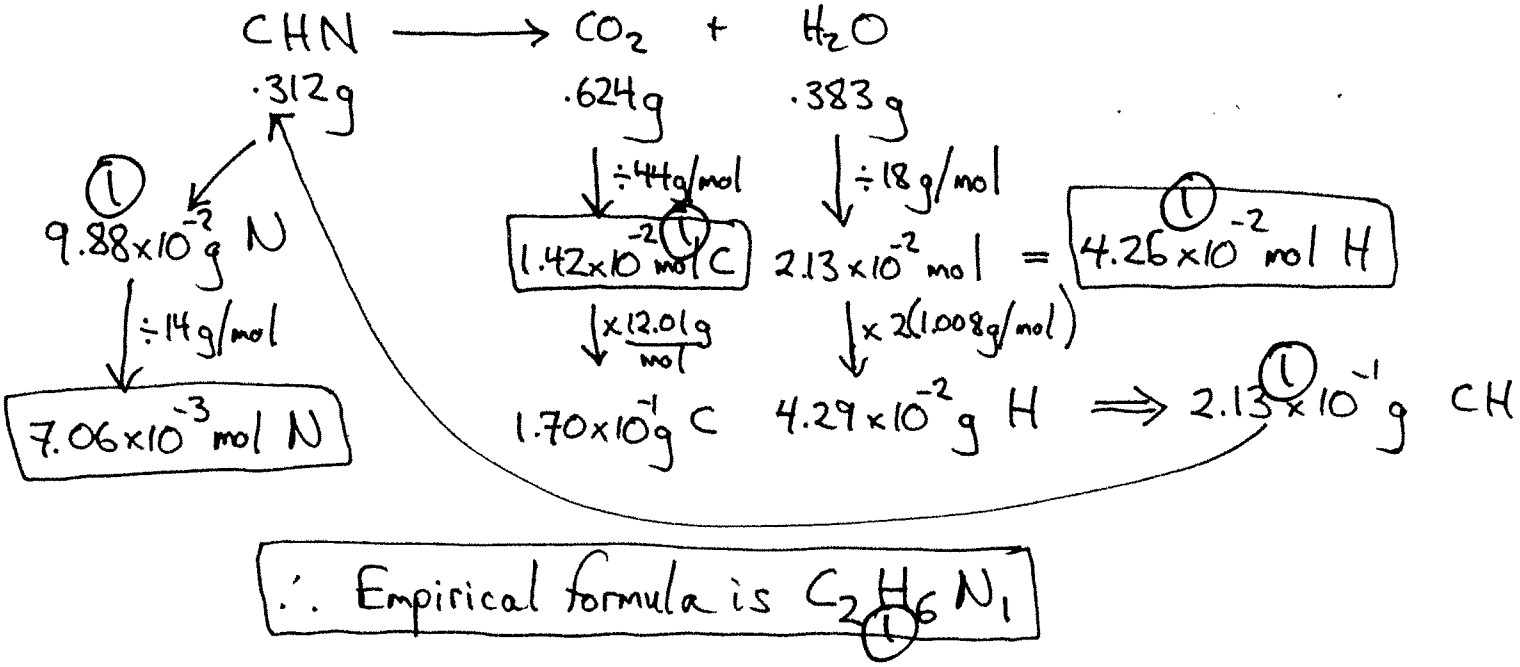
Hydrogen phosphite $H_3PO_3$

(3) 4) A sample of toluene, $C_7H_8$, (MW = 92.1 g/mol) contains 4.73 g of carbon. Calculate the weight of the toluene sample.

$$\frac{4.73\ \text{g C}}{12.01\ \text{g/mol}} = .394\ \text{mol C}\ (1) \times \frac{C_7H_8\ (1)}{7\ \text{C}} \times \frac{92.1\ \text{g}}{\text{mol}}$$

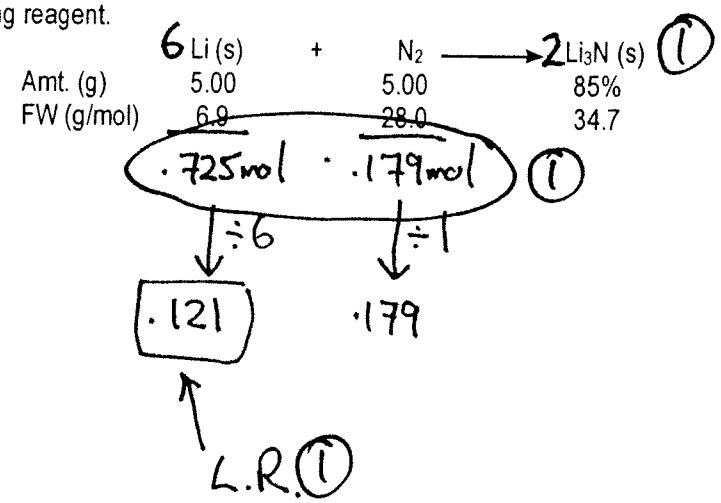
$$= 5.18\ (1)\ \text{g toluene}$$

(5) 5) Tetramethyl hydrazine is a carbon-hydrogen-nitrogen compound used in rocket fuels. When burned completely, a 0.312 gram sample yields 0.624 g of $CO_2$ (MW = 44 g/mol) and 0.383 g of $H_2O$ (MW = 18 g/mol). Calculate the empirical formula of tetramethyl hydrazine.




6) Consider the reaction of 5.00 g <u>each</u> of lithium and nitrogen gas to form lithium nitride in an 85% yield.

(3) a) Calculate the limiting reagent.



(3) b) Calculate how many grams of $Li_3N$ were made according to the given information.

$$.725 \text{ mol } Li \times \frac{2Li_3N}{6Li} \times \frac{34.7 g}{mol} \times .85$$ (1) (1)

$= 7.1 g$ (1)

7) An unknown acid solution is either 8.1 mL of 7.4 M $H_3PO_4$ or 3.2 mL of 4.0 M $H_2SO_4$. It required 10.67 mL of 1.2 M $Ca(OH)_2$ to neutralize the unknown acid solution.

(3) a) What is the identity of the unknown acid solution. Fully explain.

1.2 mol in 1000 mL $\times = 1.28 \times 10^{-2}$ mol $Ca(OH)_2$ $\therefore 2.56 \times 10^{-2}$ (1) mol $OH^{\ominus}$

as x " " 10.67 "

7.4 mol in 1000 mL $\times = 5.99 \times 10^{-2}$ mol $H_3PO_4$ $\therefore 1.80 \times 10^{-1}$ mol $H^{\oplus}$

as x " " 8.1 mL

4.0 mol in 1000 mL $\times = 1.28 \times 10^{-2}$ mol $H_2SO_4$ $\therefore 2.56 \times 10^{-2}$ (1) mol $H^{\oplus}$

as x " " 3.2 mL

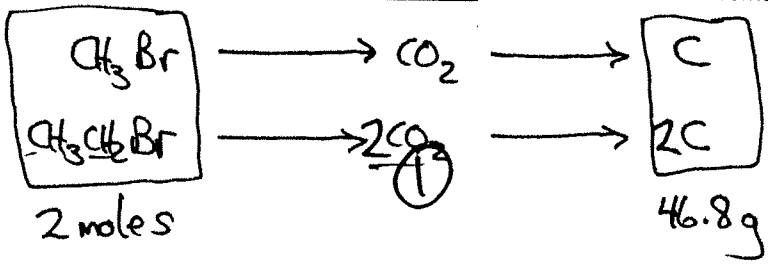
$\therefore$ unknown acid sol$^{n}$ = (1) $H_2SO_4$

(3) b) Water (22.4 mL) was added to the neutralized solution. Calculate the molarity of the $Ca^{2+}$ ions.

Have $1.28 \times 10^{-2}$ (1) mol $Ca^{(2+)}$ in a volume of $(10.67 + 3.2 + 22.4)$ mL (1)

$$\frac{1.28 \times 10^{-2} \text{ mol}}{36.27 \text{ mL}} = \frac{1.28 \times 10^{-2} \text{ mol}}{.03627 L} = 0.4 M = 0.35 M$$ (1)

(5) 8) A sample of bromomethane, $CH_3Br$, (MW = 94.9 g/mol) and bromoethane, $CH_3CH_2Br$, (MW = 109.0 g/mol) together contains 2.00 moles of molecules. The sample is burned in excess $O_2$ gas to produce $CO_2$ which is reduced to 46.8 g of carbon. Calculate the **% ratio by mass** of bromomethane to bromoethane in the original sample.




Let $x$ = moles $CH_3Br$ (1)
$2-x$ = moles $CH_3CH_2Br$

$x(12.01) + (2-x)(2)(12.01) = 46.84$ (1)

$12.01x + 48.04 - 24.02x = 46.84$

$-12.01x = -1.200$

$x = .10$ mole $CH_3Br$ (1) $\longrightarrow$ 9.48 g $CH_3Br$

1.90 mole $CH_3CH_2Br$ $\longrightarrow$ 207.11 g $CH_3CH_2Br$

216.59 g

$\therefore$ 4.38 % : 95.6 % (1)
$CH_3Br$ $CH_3CH_2Br$

(1) (1) Bonus. True or (False) The names of the authors of your textbook can be found on its cover.